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None

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G3N
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(54) Automatic door system and method for controlling opening/closing operation of automatic door in its extraneous condition

(57) An automatic door system, and a method for controlling an automatic door system, even when an extraneous condition occurs due to some obstacle clogging a travelling lane of the door. The door can move at a high speed to its deceleration point so as to immediately enable a man to go through the door opening, while the door is prevented from colliding at a high speed against the obstacle repeatedly by adjusting its pattern of operation to the restricted length of the travelling lane.

FIG. 5

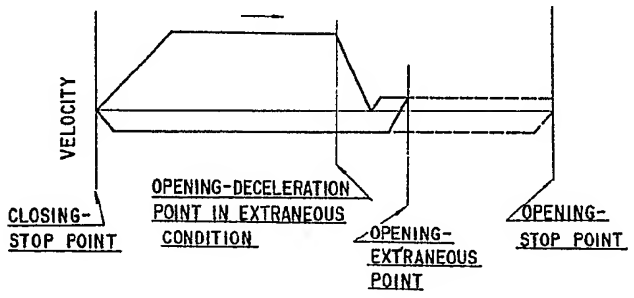

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FIG. 1

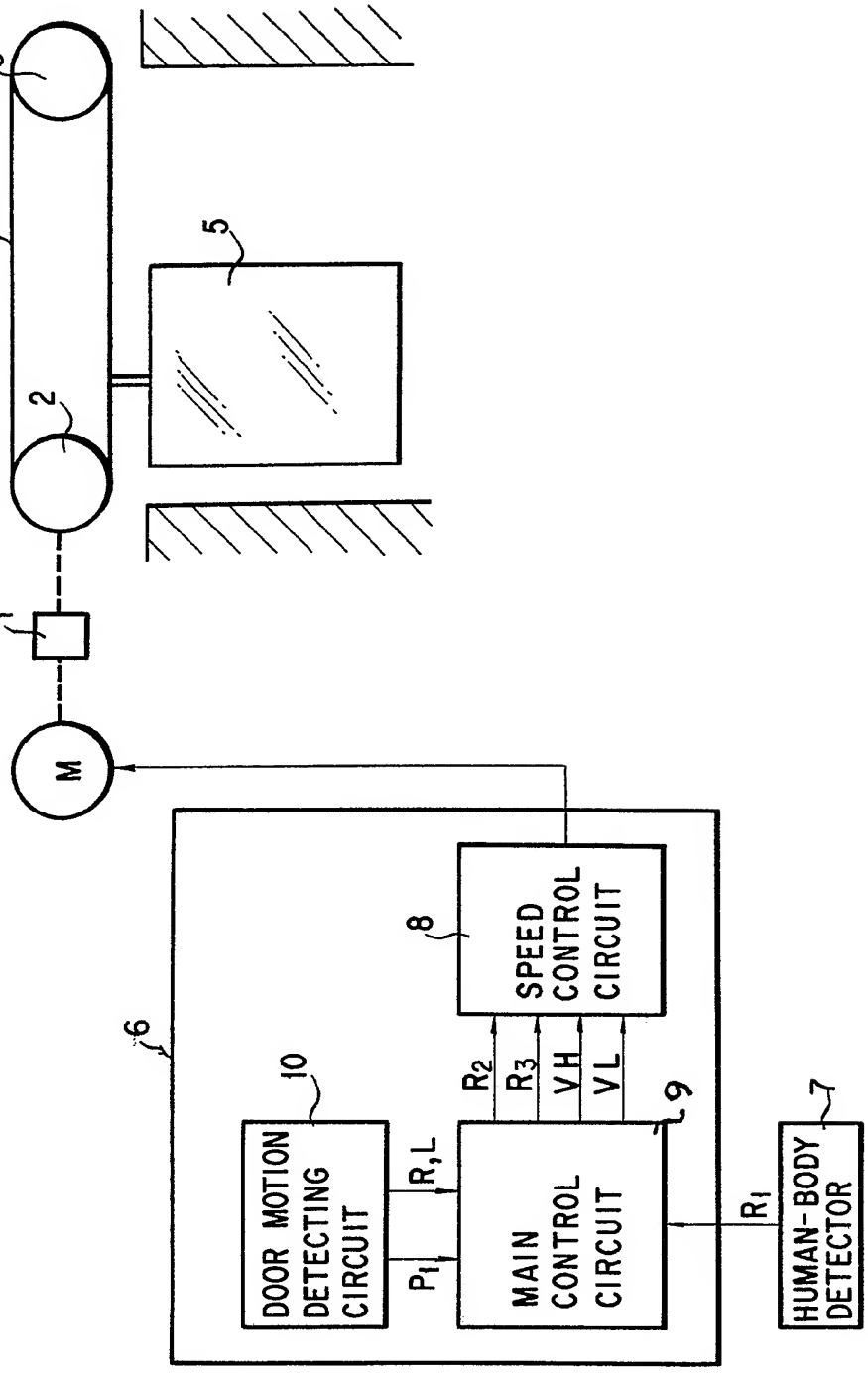
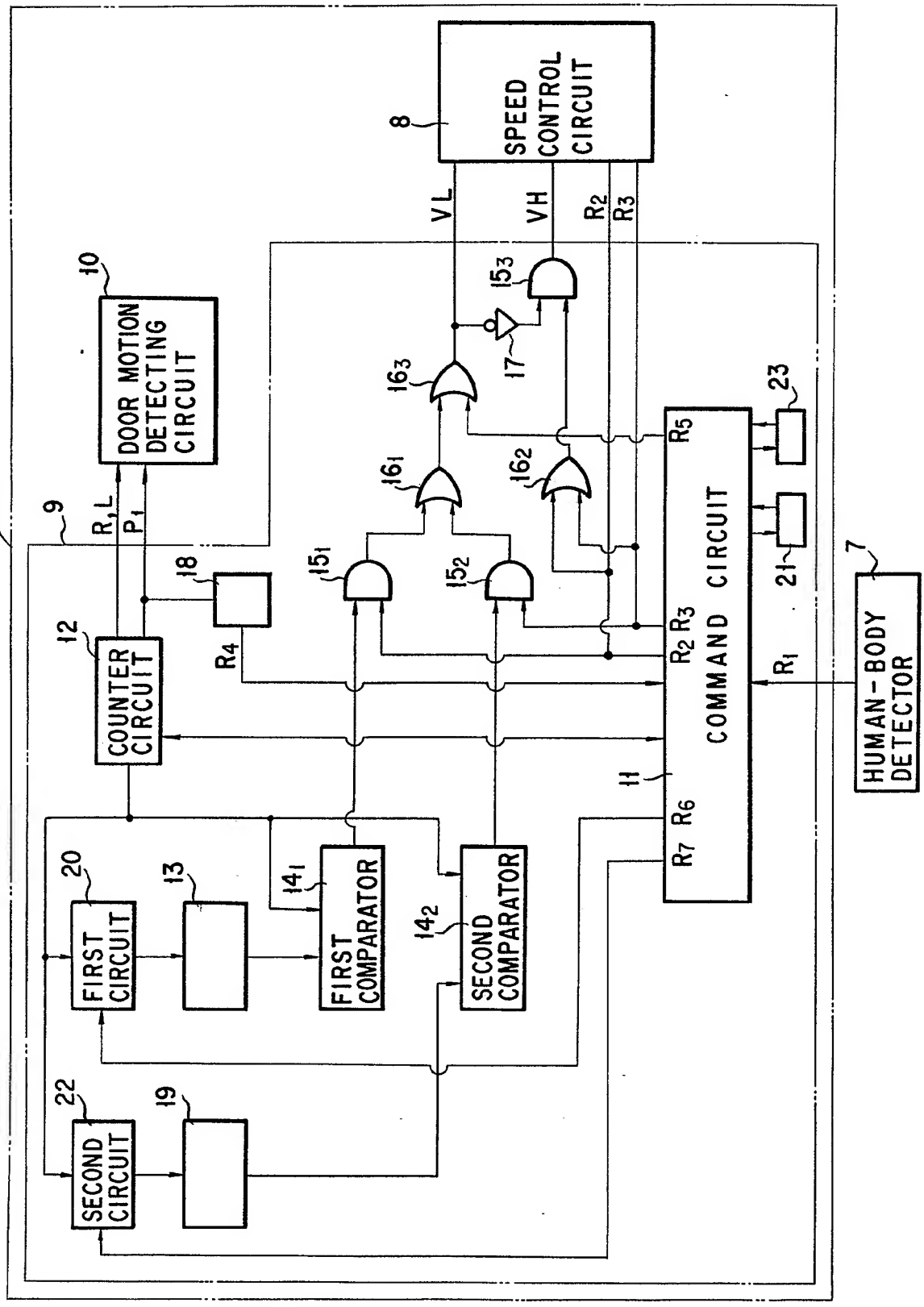


FIG. 2



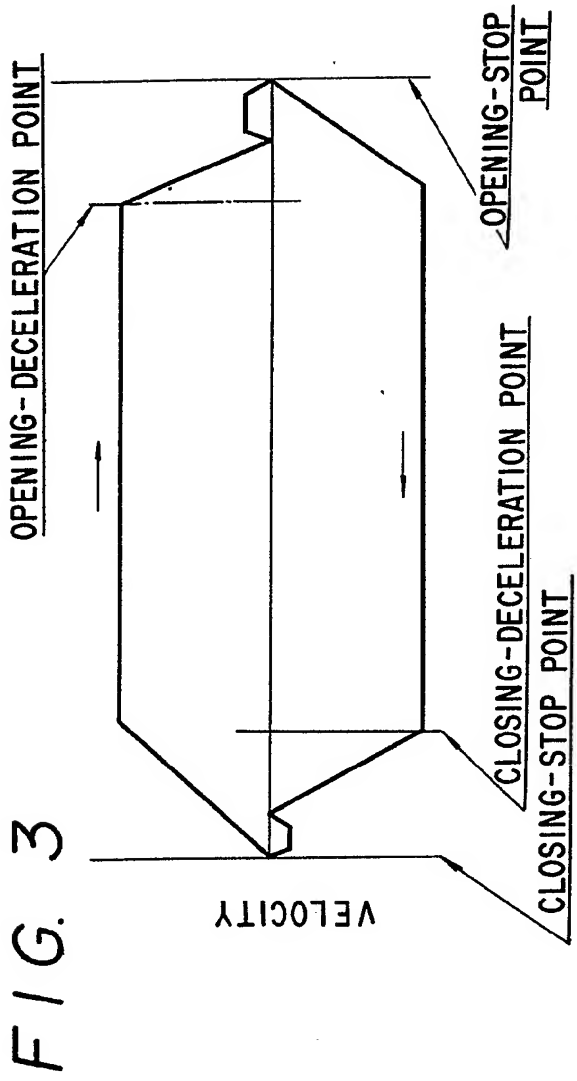


FIG. 3

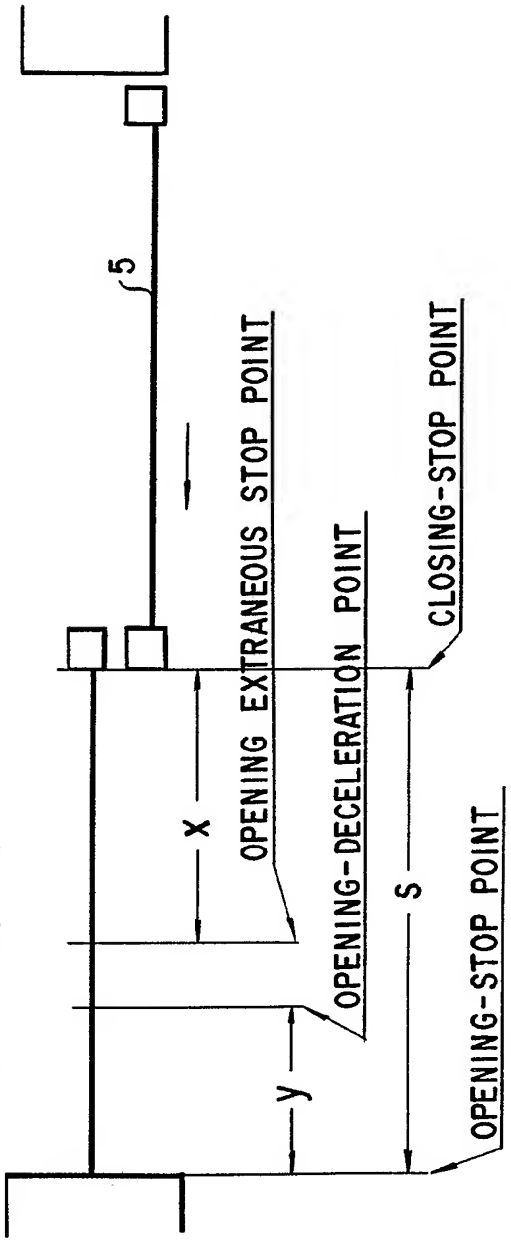


FIG. 4

FIG. 5

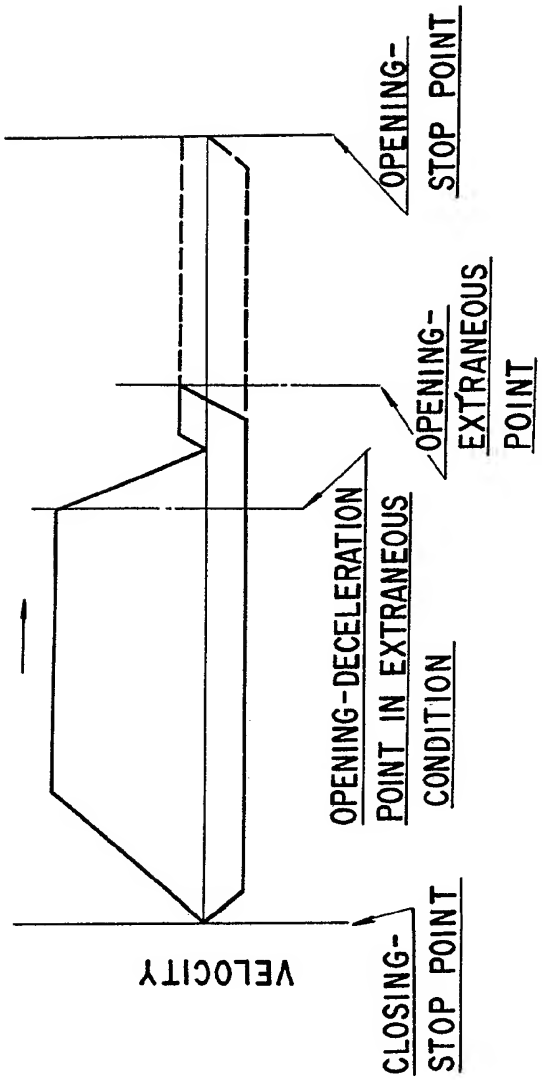


FIG. 6-1

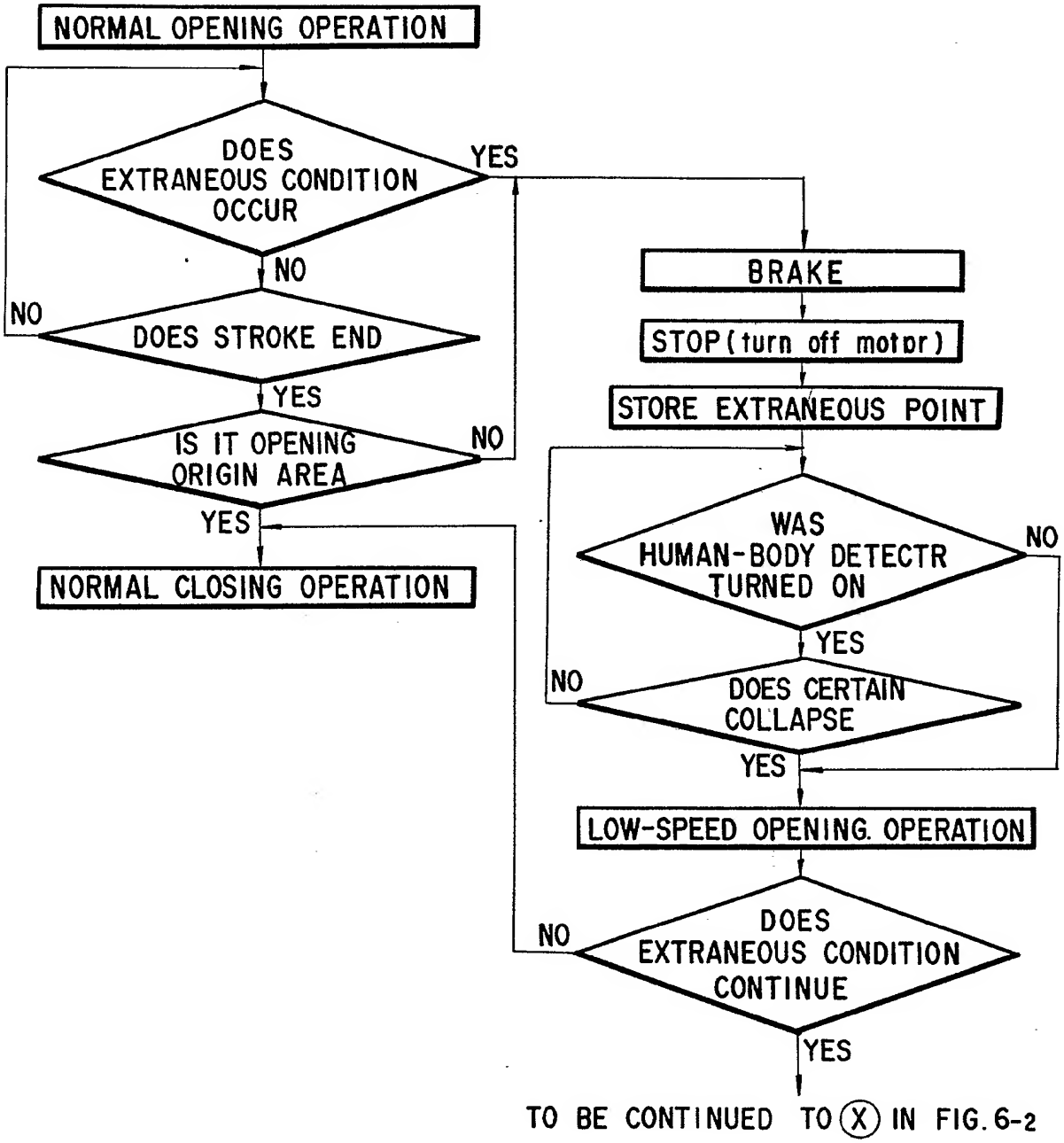


FIG. 6-2

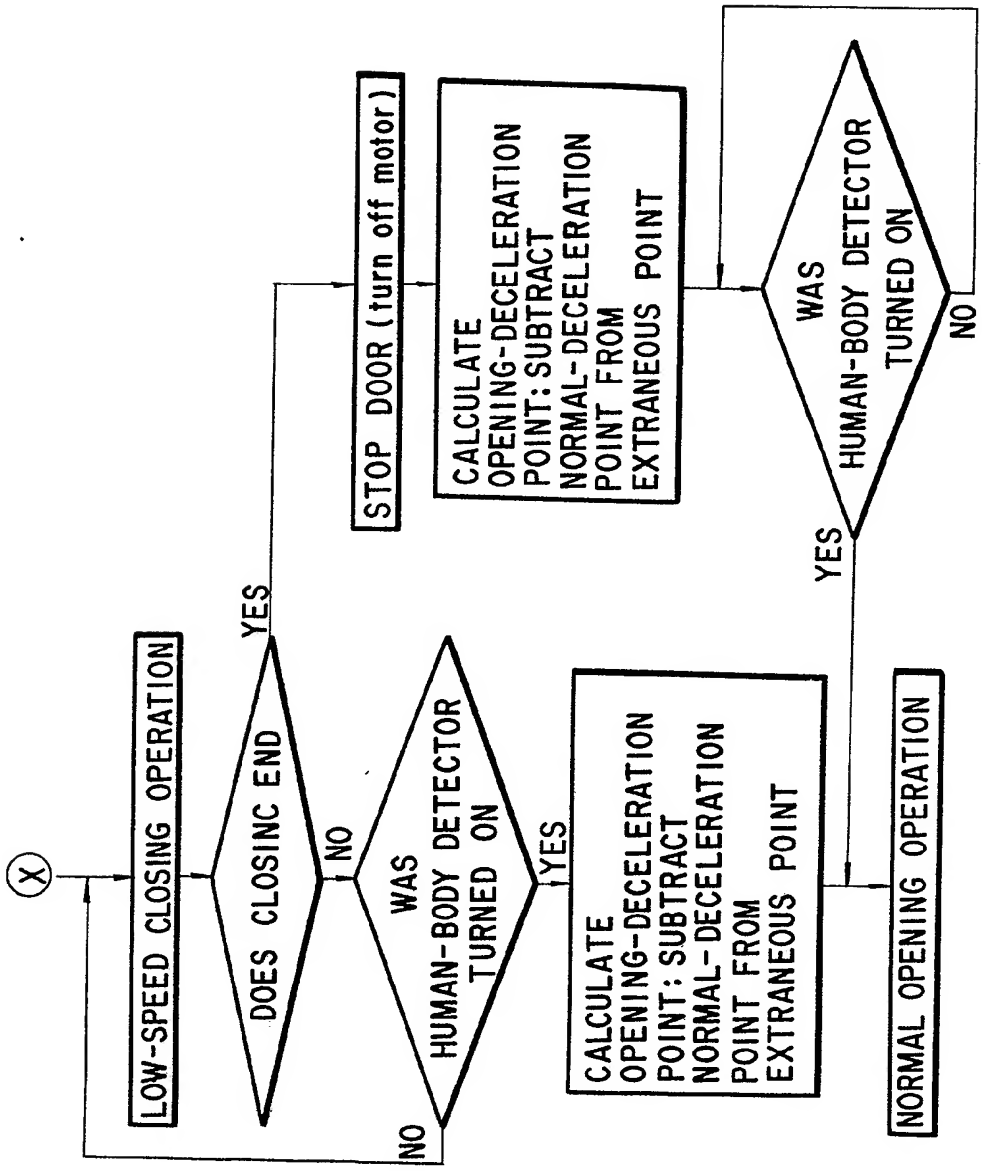


FIG. 7

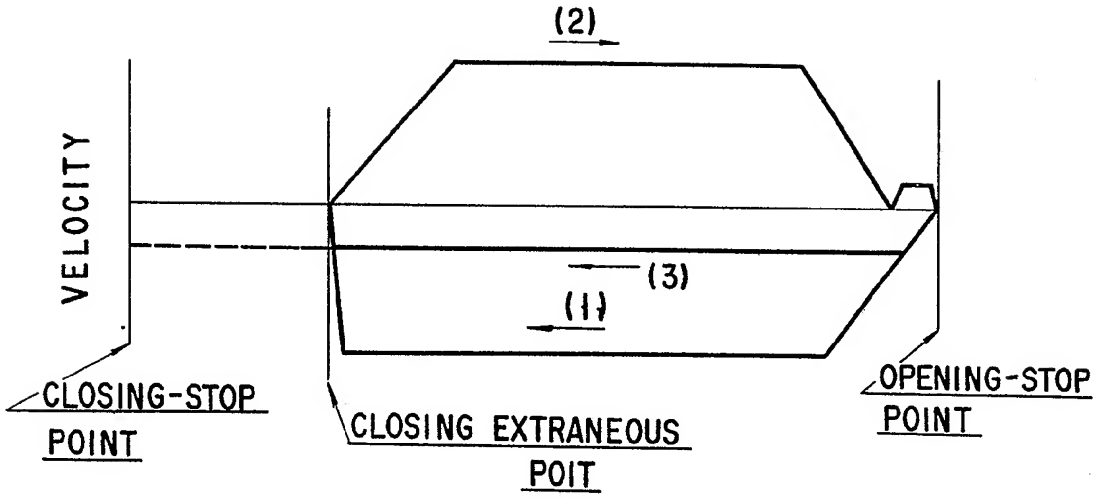


FIG. 8

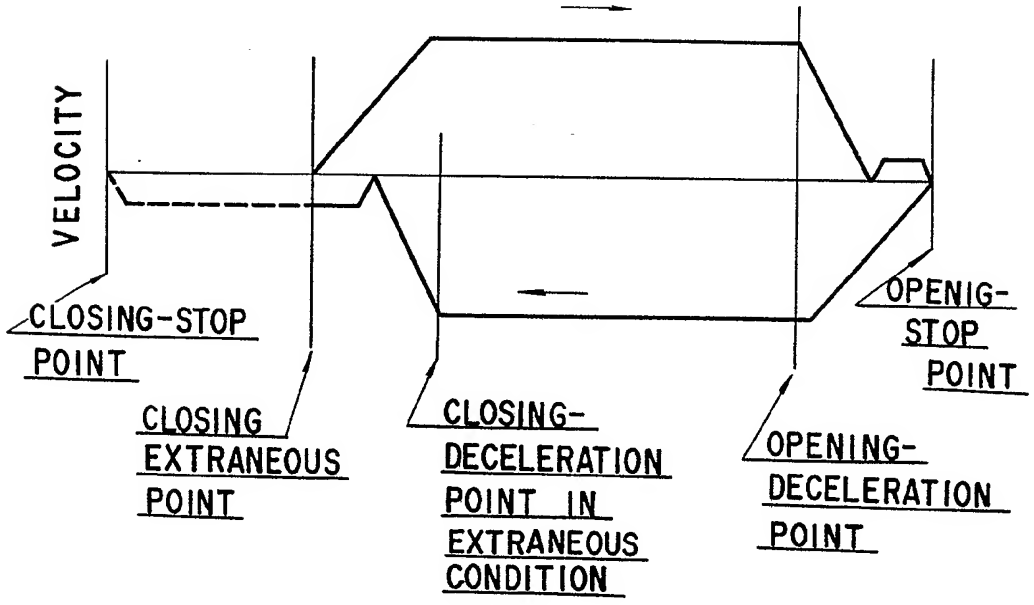


FIG. 9-1

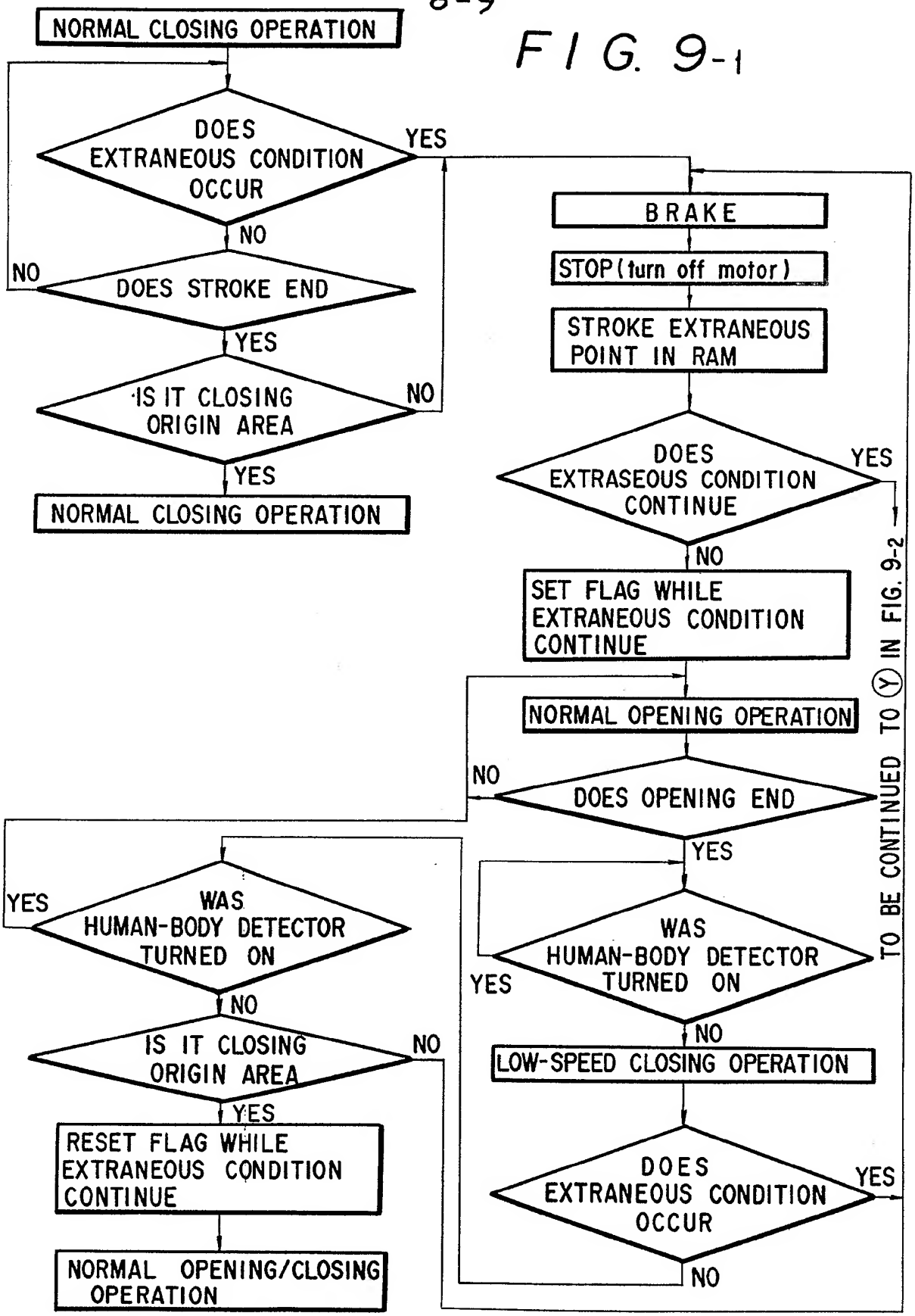
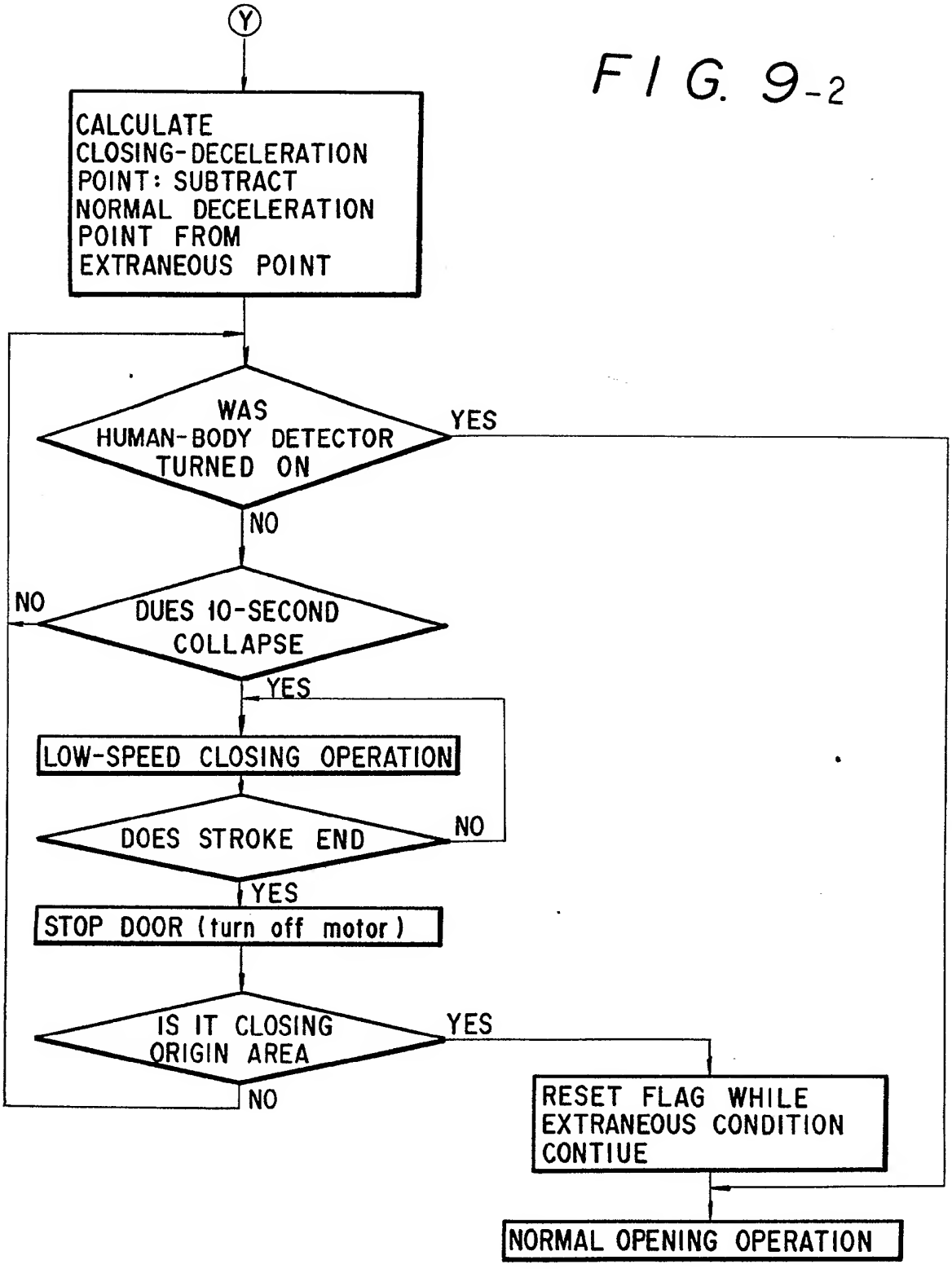


FIG. 9-2


Y
CALCULATE CLOSING-DECELERATION POINT: SUBTRACT NORMAL DECELERATION POINT FROM EXTRANEOUS POINT
WAS HUMAN-BODY DETECTOR TURNED ON
YES
NO
NO
DUES 10-SECOND COLLAPSE
YES
LOW-SPEED CLOSING OPERATION
DOES STROKE END
NO
YES
STOP DOOR (turn off motor)
IS IT CLOSING ORIGIN AREA
YES
NO
RESET FLAG WHILE EXTRANEOUS CONDITION CONTIUE
NORMAL OPENING OPERATION

SPECIFICATION

Automatic door system and method for controlling opening/closing operation of automatic door in its extraneous condition

Background of the invention

Field of the invention

This invention relates to an automatic door system and and a method for controlling a door in an automatic door system, and more particularly to a method for controlling the opening/closing operation of a door in an automatic door system when an extraneous condition of the door occurs.

Description of the prior art

In a conventional automatic door system, when there is a human-body detection signal in a normal operation of a door of the system, the door thereof conducts its high-speed opening operation until it reaches a deceleration point thereof in its opening operation, and thereafter conducts its low-speed opening operation until the door reaches its stop point in the opening operation thereof (hereinafter referred to as the opening-stop point). After the door's arrival in the opening-stop point, the door conducts its high-speed closing operation until it reaches a deceleration point thereof in its closing operation. After the door's arrival in the deceleration point, the door conducts its low-speed closing operation until it reaches a stop point thereof in its closing operation (hereinafter referred to as the closing-stop point).

In such a normal opening/closing operation of the door, when a traveling lane of the door is clogged with some obstacle such as a stone and the like, the door collides with such obstacle to cause an extraneous condition of the door in its operation.

Hitherto, in such extraneous condition, the door conducts its low-speed opening/closing operation to move to its opening-stop point or to its closing-stop point, so that the opening-stop point or the closing-stop point of the door is checked and then a normal opening/closing operation of the door is conducted.

In such opening/closing control of the door conducted in the extraneous condition of the same, the low-speed opening/closing operation of the door is repeated before completion of a check on the opening-stop point or the closing-stop point of the door, so that, in case that as human-body detection signal is inputted before completion of such check, the low-speed opening-closing operation of the door is repeated to delay a man's going through the door opening. Such delay is not preferable in use and constitutes a disadvantage inherent in a conventional method for controlling the automatic door in its opening/closing operation when an extraneous condition of the door occurs.

Summary of the invention

According to a first aspect of the present invention there is provided a method for controlling a door of an automatic door system in an extraneous condition occuring in its opening/closing operation, which door conducts its opening/closing operation between an opening-stop point and a closing-stop point according to a predetermind opening/closing operation mode, wherein the method comprises the steps of:

(a) establishing an opening-deceleration point or a closing-deceleration point on the basis of a position of said door at a time when said extraneous condition occurs, said position being considered as said opening-stop point or said closing-stop point when a human-body detection signal is inputted to have said door conduct said opening/closing operation thereof.

According to a second aspect of the present invention there is provided an automatic door system comprising a door which conducts its opening/closing operation between an opening-stop point and closing-stop point according to a predetermined opening/closing operation mode, wherein the system comprises:

(a) means for establishing an opening-deceleration point or a closing-deceleration point on the basis of a position of said door at a time when an extraneous condition occurs in its opening/closing operation, said position being considered as said opening-stop point or said closing-stop point in said establishing; and

(b) means for moving said door at a high speed to said opening-stop point or said closing-stop point when a human-body detection signal is inputted to have said dorr conduct said opening/closing operation thereof.

According to a third aspect of the present invention there is provided a method of operating an automatic door system in which a deceleration point is established according to a position of the door at a time when such extraneous condition occurs; and, in case that a human-body detection signal is inputted, the door moves at a high speed to the above deceleration point so that the door is controlled in its opening/closing operation to swiftly conduct its opening/closing operation even when the extraneous condition occurs, so that a man may immediately go through the door opening while the door is prevented from colliding the obstacle in the extraneous condition occurring point.

It is believed possible by means of the present invention to provide a method for controlling an automatic door in its opening/closing operation when an extraneous condition of the door occurs in such operation, without causing the above-mentioned delay inherent in the conventional method.

Brief descriptiono of the drawings

The invention will be described by way of example with reference to the accompanying drawings, wherein like references refer to like parts unless the context requires otherwise.

Figure 1 is a schematic view illustrating an automatic door system for working the method of the present invention;

Figure 2 is a block diagram illustrating a control apparatus employed in the automatic door system of Figure 1;

Figure 3 is a graph showing a normal opening/closing operation of the door of the automatic door system of Figure 1;

Figure 4 is a diagram for illustrating a manner for establishing the deceleration point of the door in its opening/closing operation;

Figure 5 is a graph showing the operation of the door in the extraneous condition occurring in its opening operation;

Figure 6 is a flow chart illustrating the operation of the automatic door system conducted in the extraneous condition occurring in the opening operation of the door;

Figure 7 and *8* are graphs showing the operations of the door conducted in the extraneous condition occurring in the closing operation of the door; and

Figure 9 is a flowchart illustrating the operation of the automatic door system conducted in the extraneous condition occurring in the closing operation of the door.

Description of the preferred embodiment

Hereinbelow, an embodiment of a method of the present invention will be described with reference to the accompanying drawings, wherein the reference numeral 5 denotes a door of an automatic door system for working the embodiment of the present invention.

Figure 1 is a schematic view illustrating the automatic door system for working the method of the present invention, wherein: the reference character M denotes a motor connected with a driving pulley 2 through a reduction gear 1. The door 5 is connected to a belt 4 running around a driving pulley 2 and its driven pulley 3. The motor M is controlled in its actuation, and in direction and speed in its rotation by means of a control unit 6 of the automatic door system.

The control unit 6 comprises: a speed-control circuit 8 for the motor M; a main control circuit 9 for issuing a normal-rotation signal R_2, a reverse-rotation signal R_3, a high-speed signal VH and a low-speed signal VL to the speed-control circuit 8 so as to control a normal opening/closing operation of the door 5 after receiving a human-body detection signal R_1 issued from a human-body detector 7 such as a mat switch and the like; and a door-motion detecting circuit 10 for identifying clock pulses P_1 proportional to a traveling distance of the door 5 in counting use and for identifying the opening/closing operation of the door 5, so as to issue an opening signal R for the door 5 and a closing signal L for the door 5, which door-motion detecting circuit 10 comprises a detector and a direction-identifying circuit as disclosed in Japanese Patent Application Laid-Open Specification No. 58-210271.

Now, the detail of the operation of the door 5 will be described with reference to Figures 1 to 9.

(1) In a normal opening/closing operation:

When human-body detection signal R_1 is inputted to a command circuit 11 from the human-body detector 7, the command circuit 11 issues the normal rotation signal R_2 to the speed-control circuit 8, while the clock pulses P_1 are counted by a counter circuit 12 to detect a position of the door 5 under consideration, a signal of which position issued from the counter circuit 12 is compared with a signal of a deceleration point in the opening operation of the door 5 (hereinafter referred to as the opening-deceleration point) issued from an opening-deceleration-point setting unit 13 in a first comparator 14_1. Provided that the door 5 does not reach the opening-deceleration point, the first comparator 14_1 does not issue any signal to a first AND gate 15_1 so that the first AND gate 15_1 does not issue any signal. On the other hand, the normal rotation signal R_2 is also inputted to a second OR gate 16_2 to have the same 16_2 issue a signal to a third AND gate 15_3 to which is also inputted a signal issued from an inverter 17, so that the third AND gate 15_3 issues the high-speed signal VH to the speed-control circuit 8, whereby the motor M rotates at a high speed in its normal direction to cause the door 5 to conduct its high-speed opening operation.

When the door 5 reaches the opening-deceleration point as counted by the counter circuit 12, the first comparator 14_1 issues a signal to the first AND gate 15_1 and in turn the first AND gate 15_1 issues a signal to a first OR gate 16_1 which issues a signal to a third OR gate 16_3 which issues the low-speed signal VL to the speed-control circuit 8, while the inverter 17 does not issue its signal to the third AND gate 15_3 to cause the same 15_3 not to issue the high-speed signal VH to the speed-control circuit 8 for the motor M so that the motor M rotates at a low speed in its normal direction to cause the door 5 to conduct is low-speed opening operation.

When the door 5 reaches an opening-stop point, a pulse-interval check circuit 18 detects a long pulse interval of the clock pulses P_1 to issue a signal R_4 to the command circuit 11 so that the command circuit 11 issues a stop signal to the speed-control circuit 8 to cause the motor M to brake to a stop. Then, after a delay of a certain time, the command circuit 11 issues the reverse-rotation signal R_3 to both the speed-control circuit 8 and and a second AND gate 15_2, while the clock pulses P_1 are counted by a counter circuit 12 to detect a position of the door 5 under consideration.

In this case, the position of the door 5 under consideration is counted by the counter circuit 12 and compared by the second comparator 14_2 with a deceleration point in the closing operation of the door 5 (hereinafter referred to as the closing-deceleration point) set by a closing deceleration point setting unit 19. In case that the thus counted

value of the position of the door 5 is larger than a value showing the closing-deceleration point, the second cmparator 14_2 does not issue any signal to the second AND gate 15_2 to cause the same 15_2 not to issue any signal, so that the third AND gate 15_3 issues the high-speed signal VH to the speed-control circuit 8 for the motor M to cause the same M to rotate at a high speed in its reverse direction, whereby the door 5 conducts its high-speed closing operation.

When the door 5 reaches the closing-deceleration point, the second comparator 14_2 issues a signal to the second AND gate 15_2 which issues a signal to the first OR gate 16_1 which issues a signal to the third OR gate 16_3 which issues the low-speed signal VL to the speed-control circuit 8 for the motor M as in the same manner as described above to cause the motor M to rotate at a low speed in its reverse direction, whereby the door 5 conducts its low-speed closing operation. When the door 5 reaches a closing-stop point, the pulse-interval check circuit 18 issues the detection signal R_4 to the command circuit 11 to cause the motor M to brake to a stop in the same manner as described in the above, so that the door 5 stops at the closing-stop point.

The above operation of the door takes the form of a graph shown in Figure 3.

(2) In the opening operation in which an extraneous condition of the door 5 occurs:

The extraneous condition of the door 5 means a case in which the door 5 is unable to increase its speed in spite of its high-speed opening operation, a case in which the door 5 is stopped in an area outside an area of the opening-deceleration point thereof, and the like case. The cause of such extraneous condition is a stone and the like obstacle clogging the traveling lane of the door 5.

Such extraneous condition is detected by means of the singal R_4 issued from the pulse-interval check circuit 18, which signal R_4 is inputted to the command circuit 11 to cause the same 11 to issue the stop signal to the speed-control circuit 8 for the motor M so that the motor M brakes to a sudden stop, whereby the door 5 is stopped.

In this case, a number counted in the counter circuit 12, i.e., a position of the door 5 under consideration is inputted to a first circuit 20, which stores the extraneous condition occurring point in the opening operation of the door 5 and calculates a deceleration point in the opening operation of the door 5 (hereinafter referred to as the opening deceleration point upon the extraneous condition), as the extraneous condition occurring point is considered as a temporary stop point in the opening operation of the door 5 (hereinafter referred as the opening-stop point upon the extraneous condition), while a flag 21 for storing the extraneous condition occurring in the opening operation of the door 5 is set (hereinafter referred to as the opening-extraneousness storing flag 21).

Thereafter, the human-body detection signal R_1 is checked as to whether it is present or not. In case that the human-body detection signal R_1 is present for a certain time, for example, for at least 5 seconds, the command circuit 11 issues both the normal rotation signal R_2 and a low-speed signal R_5 in the extraneous condition (hereinafter referred to as the extraneous low-speed signal R_5) so that the door 5 is moved at a low speed in its opening direction whereby it is checked as to whether the extraneous condition continues or not. This check on the continuance of the extraneous condition may be performed by checking the opening-extraneousness storing flag 21. Namely, in case that the extraneous condition disappears, the flag 21 is reset to make it possible to know the discontinuance of the extraneous condition.

On the other hand, in case that the human-body detection signal R_1 does not continue for at least the certain time, the door 5 conducts its low-speed opening operation again as is in the above-mentioned case, and then in case that the extraneous condition still continues, the command circuit 11 issues both the reverse rotation signal R_3 and the extraneous low-speed signal R_5 to cause the door 5 to conduct its low-speed closing operation, whereby, in case that the extraneous condition disappears, the door 5 can reach the opening-stop point to make it possible to know the fact that the extraneous condition disappears, so that in the following closing operation of the door 5, the door 5 conducts its normal closing operation, while the opening-extraneous storing flag 21 is reset.

In case that the human-body detection signal R_1 is inputted to the command circuit 11 again in the low-speed closing operation of the door 5 mentioned above, the command circuit 11 issues the normal rotation signal R_2 to the speed-control circuit 8 for the motor M to cause the door 5 to conduct its high-speed opening operation as is in its normal opening/closing operation. At the same time, the command circuit 11 issues also a signal R_6 for changing the opening-deceleration point (hereinafter referred to as the opening-deceleration-point changing signal R_6) to the first circuit 20 so that a set value established in the opening-deceleration-point setting unit 13 is changed to a value calculated in the first circuit 20.

Namely, as shown in Figure 4, wherein: the reference character S denotes an effective stroke of the dor 5, i.e., a distance between the opening-stop point and the closing-stop point in the normal opening/closing operation; y a deceleration area in the normal operation of the door 5, i.e., a distance between the opening stop point and the opening deceleration point; and x a stroke of the door 5, i.e., the distance between the extraneous condition occurring point and the closing-stop point, even when the deceleration point is set in an area of "S − y" in the normal operation of the door 5, that is set in an area of "x − y" after occurrence of the extraneous condition.

Consequently, when the door 5 reaches a position spaced apart from the previous extraneous

condition occurring point by a distance of the deceleration area, the first comparator 14_1 issues a signal to the first AND gate 15_1 to eventually cause the third OR gate 16_3 to issue the low-speed signal VL to the speed-control circuit 8 for the motor M as in the case of the normal opening/closing operation of the door 5, so that the door 5 conducts its low-speed opening operation to gently abut on the previous extraneous condition occurring point and continuously urge the same without colliding the same point at a high speed.

In conducting the above low-speed closing operation, in case that the human-body detection signal R_1 is not inputted to the command circuit 11 so that the door 5 moves to the closing-stop point, the door 5 stops at that point and the command circuit 11 issues the opening-deceleration-point changing signal R_6 to the first circuit 20 to change the set value established in the opening-deceleration-point setting unit 13 in the same manner as that described in the above, so that the door 5 stays as it is until the following human-body detection signal R_1 is inputted to the command circuit 11. When the human-body detection signal R_1 is inputted to the command circuit 11. When the human-body detection signal R_1 is inputted to the command circuit 11, the door 5 operates as in its normal opening/closing operation. However, in this case, the opening-deceleration point has been already changed as described in the above to the opening deceleration point upon the extraneous condition so that the door 5 is prevented from colliding against the previous extraneous condition occurring point at a high speed.

The above operation of the door 5 takes the form of a graph shown in Figure 5, and also takes the form of a flowchart shown in Figure 6.

(3) In the closing operation in which the extraneous condition of the door 5 occurs:

The occurrence of the extraneous condition is detected as is in the opening operation of the door 5, and the command circuit 11 issues the stop signal to the speed-control circuit 8 for the motor M to cause the same M to brake to a stop so that the door 5 stops at the extraneous condition occurring point.

At the same time, a counted number, i.e., a position of the door 5 under consideration is inputted to a second circuit 22, which stores the extraneous condition occurring point in the closing operation of the door 5 and calculates the deceleration point in the same operation, which extraneous condition occurring point is considered as a temporary stop point in the closing operation of the door 5 (hereinafter referred to as the closing-stop point upon the extraneous condition) in calculation of a deceleration point in the closing operation of the door 5 (hereinafter referred to as the closing deceleration point), while a flag 23 for storing the extraneous condition occurring in the closing operation of the door 5 (hereinafter referred to as the closing-extraneousness storing flag 23) is checke as to whether it is set or not.

Namely, it is checked as to whether the extraneous condition occurs in the previous closing operation of the door 5, and in case that the closing-extraneousness storing flag 23 is reset, it is considered that the extraneous condition does not occur in the previous closing operation of the door 5 and that the extraneous condition under consideration is the first one occurring in the closing operation of the door 5 so that the closing-extraneousness storing flag 23 is set. At the same time, the command circuit 11 issues the normal rotation signal R_2 to the speed-control circuit 8 for the motor M to immediately cause the door 5 to conduct its high-speed opening operation.

This high-speed opening opertion of the door 5 is required to have the door 5 quickly disengage from the obstacle such as a man and the like in case that the door 5 hits the obstacle.

Then, when the human-body detection signal R_1 is not inputted to the command circuit 11, the command circuit 11 issues both the reverse rotation signal R_3 and the extraneous low-speed signal R_6 to have the door 5 conduct its low-speed closing operation so as to check whether the extraneous condition occurs or not. In case that the extraneous condition does not occur, for example, when a man goes through the door opening, the door 5 moves to its closing-stop point to make it possible to consider that there is no extraneousness storing flag 23 is reset, whereby the door 5 returns to its normal opening/closing operation. The above operation of the door 5 takes the form of a graph shown in Figure 7.

On the other hand, in case that the extraneous condition occurs again in the operation of the door 5 to stop the same halfway, since the closing-extraneousness storing flag 23 is set, it is possible to consider that the extraneous condition under consideration is the following one, so that the door 5 conducts the same operation as is in the case in which the extraneous condition is repeated at least two times as described later.

Namely, in case that the closing-extraneousness storing flag 23 has been set at a time when the extraneous condition occurs, since the extraneous condition is repeated at least two times, the door 5 stays at the extraneous condition occurring point.

Such a stay of the door 5 is required, for example, to prevent the door 5 from conducting its opening/closing operation repeatedly and to let a man known the position of the extraneous condition occurring point when the travelling lane of the door 5 is clogged with the obstacle such as a stone and the like.

In coincidence this, the command circuit 11 issues a signal R_7 for changing the closing-deceleration point (hereinafter referred to as the closing-deceleration point changing signal R_7) to the second circuit 22 so that the set value established in the closing-deceleration-point setting unit 19 is replaced with a resultant value obtained by subtracting the amount of a normal deceler-

ation area from the value of the extraneous condition occurring point in the closing operation of the door 5 (hereinafter referred to as the closing extraneous point).

Under such circumstances, in case that the human-body detection signal R_1 is inputted to the command circuit 11, the door 5 conducts the above-mentioned opening/closing operation and stops again at the closing extraneous point. At this time, since the value of the closing-deceleration point has been replaced with the above-mentioned resultant value, the door 5 stops gently without colliding against the closing extraneous point.

The above operation of the door 5 takes the form of a graph shown in Figure 8.

On the other hand, in case that the human-body detection signal R_1 is not inputted to the command circuit 11 after collapse of at least a certain time when the door 5 stops at the closing extraneous point, both the reverse rotation signal R_3 and the extraneous low-speed signal R_5 are issued from the command circuit 11, for example, at 10 second-intervals to have the door 5 conduct its low-speed closing operation so as to make an effort to move the door 5 to the closing-stop point. When the door 5 reaches the closing-stop point, it is possible to consider that the door 5 is released from the extraneous condition thereof, so that the closing-extraneousness storing flag 23 is reset to return the door 5 to its normal opening/closing operation.

The above operation of the door 5 is required in view of the fact that: in case that the traveling lane of the door 5 is clogged with the obstacle such as a small piece of a stone, such small piece of the stone is often knocked off by the door 5 to make it possible that the door 5 moves to its closing-stop point.

The above operation of the door 5 takes the form of a flowchart shown in Figure 9.

In effect of the present invention, even in the extraneous condition, the door 5 is moved at a high speed to the deceleration point to immediately enable a man to go through the door opening, while prevented from colliding at a high speed against the extraneous piont repeatedly to make it possible to increase both the durability and safety of the door 5.

CLAIMS

1. A method for controlling a door of an automatic door system in an extraneous condition occurring in its opening/closing operation, which door conducts its opening/closing operation between an opening-stop point and a closing-stop point according to a predetermined opening/closing operation mode, wherein the method comprises the steps of:

(a) establishing an opening-deceleration point or a closing-deceleration point on the basis of a position of said door at a time when said extraneous condition occurs, said position being considered as said opening-stop point or said closing-stop point in said establishing; and

(b) moving said door at a high speed to said opening-stop point or said closing-point when a human-body detection signal in inputted to have said door conduct said opening/closing operation thereof.

2. A method as set forth in Claim 1, characterized in that continuation or elimination of the extraneous condition in the automatic door system is confirmed by the fact that when the door is moved at its low speed opening/closing operation, whether an opening- closing-extraneousness storing flag is resetted or not.

3. An automatic door system comprising a door which conducts its opening/closing operation between an opening-point and a closing-stop point according to a predetermined opening/closing operation mode, wherein the system comprises:

(a) means for establishing an opening-deceleration point or a closing-deceleration point on the basis of a position of said door at a time when an extraneous condition occurs in its opening/closing operation, said position being considered as said opening-stop point or said closing-stop point in said establishing; and

(b) means for moving said door at a high speed to said opening-stop point or said closing-stop point when a human-body detection signal is inputted to have said door conduct said opening/closing operation thereof.

4. A system as set forth in claim 3, characterized by means for confirming continuation or elimination of the extraneous condition in the automatic door system, when the door is moved at its low speed opening/closing operation, in response to whether an opening- or closing-extraneous storing flag is resetted or not.

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